MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EPM1076 – INTRODUCTION TO MACHINES AND POWER SYSTEMS

(TE, RE)

4 MARCH 2019
2:30 p.m. – 4:30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This booklet consists of 4 pages including cover pages with 4 questions only.
2. Attempt **ALL** questions given. All questions carry equal marks and distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary working **MUST** be shown.

Question 1

(a) A 120kVA, 6600V/330V, 60Hz single phase transformer took 10A and 436W at 100V in a short circuit test referring to the high voltage side.

(i) Determine the winding impedance components of the transformer based on short circuit test results.

[5 marks]

(ii) Calculate the voltage to be applied to the high voltage side on full load at power factor 0.8 lagging when the secondary terminal voltage is 330V.

[12 marks]

(b) Given a 500V/250V, 10kVA single phase transformer has a core loss of 250W and a full load copper loss of 450 W. If the power factor of the load is 0.6 lagging, calculate its efficiency at full load and at half-full load.

[8 marks]

Question 2

(a) A 210V, 8 poles, 65Hz, three phase induction motor is running at a slip of 5.5%. Find the:

(i) speed of the magnetic fields in revolutions per minute,

[2 marks]

(ii) speed of the rotor in revolutions per minute,

[2 marks]

(iii)slip speed of the rotor, and

[2 marks]

(iv)rotor frequency in hertz.

[2 marks]

(b) Given that the synchronous reactance of a gas turbine driven, Y connected, three phase synchronous generator is 4Ω per phase. It has been connected to an infinite bus with a phase voltage of 20kV and a frequency of 50Hz in a proper way. The armature resistance in the generator may be neglected.

(i) Sketch the equivalent circuit of the synchronous machine.

[3 marks]

(ii) State the four conditions that have to be satisfied before a synchronous machine can be synchronized to the grid.

[4 marks]

(iii)Find the induced emf voltage of the synchronous generator if it is delivering power of 15MVA to the grid at 0.85 lagging power factor.

[8 marks]

(iv)Determine the load angle of the system and suggest its value for maximum active power transfer.

[2 marks]

Continued ...

Question 3

(a) A single line diagram of simple three phase power system is shown in the Figure Q3. The generators are running on no load at their rated voltage and rated frequency. Create per phase impedance diagram with all impedances including the load impedance marked in per unit for this power system using a base apparent power of 100MVA and base line voltage of 15kV at generator G1 as common base.

[18 marks]

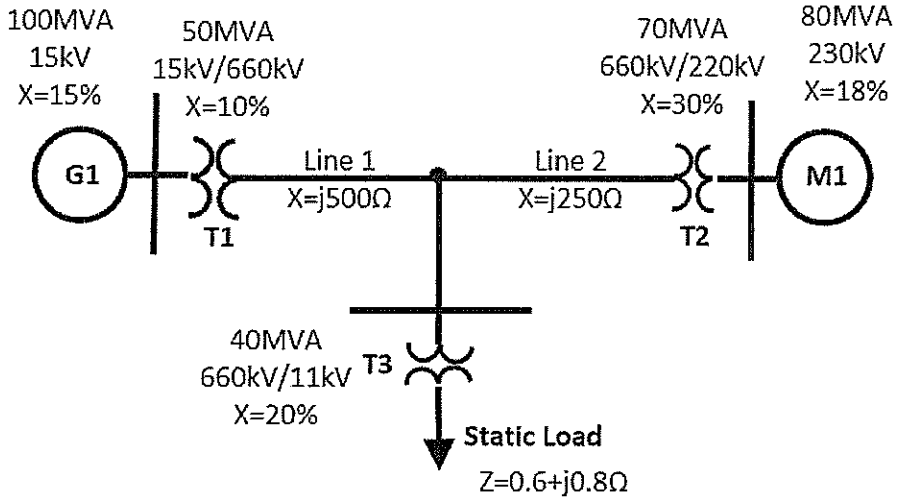

Figure Q3

(b) It is known that per unit is widely used in power system analysis. The general expression of per unit is

$$per\ unit = \frac{actual\ value}{base\ value}$$

Briefly explain the role of base value in per unit calculation and state FOUR advantages of using per unit system.

[7 marks]

Continued ...

Question 4

(a) Illustrate and describe briefly on the solid earth and resistance earth grounding schemes.

[6 marks]

(b) Give THREE considerations in choosing a good protective device for power system protection and justify your answer.

[6 marks]

(c) Two relays R1 and R2 are connected in two sections of a feeder as shown in Figure Q4c.

Relay R1: CT ratio = 300/5, plug setting = 2.5A. TMS = 0.3
Relay R2: CT ratio = 500/5, plug setting = 5A.

A fault current of 3000A occurred at point F. Find the TMS of R2 to give time grading margin of 0.5s between the relays. The operating time characteristic of relays is given in the Table Q4c.

[13 marks]

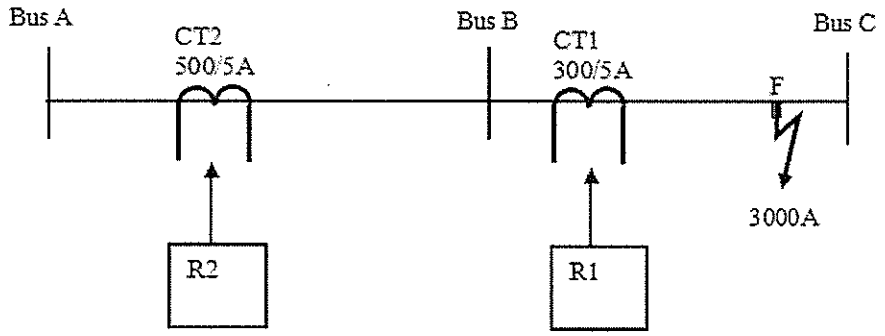

Figure Q4c

Table Q4c

PSM	2	4	6	8	10	20
T (s)	10	5	4	3	2.8	2.4

*Actual operating time of relay = T × TMS

End of Page